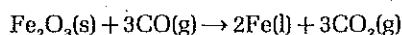
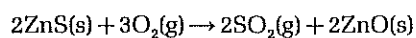


9.6 Reduction of metal oxides

Metals which exist naturally as oxide ores may be reduced directly using carbon or carbon monoxide. For example, the overall reaction for the extraction of iron from haematite in the blast furnace is:



Carbonate and sulphate ores are first converted to their oxides by heating. Zinc, for example, is obtained from zinc blende by first roasting the ore.



The oxide is then reduced with carbon or carbon monoxide.



Aim

To reduce metal oxides with carbon.

Apparatus and materials

Bunsen burner and mat

Tongs

Spatula

Ceramic paper

Carbon

Copper(II) oxide

Iron(III) oxide

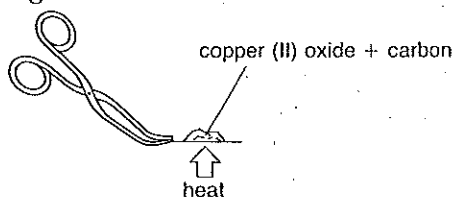
Magnesium oxide

Lead(II) oxide

Zinc oxide

Procedure

- 1 Mix three spatula measures of carbon with three spatula measures of copper(II) oxide on a piece of ceramic paper.
- 2 Use tongs to hold the ceramic paper in a roaring Bunsen flame.



- 3 Heat the mixture for 5–10 minutes.
- 4 Tip the mixture onto a mat. Inspect it for signs of copper. If copper is not visible heat for a further 5–10 minutes with three more spatula measures of carbon.
- 5 Repeat steps 1–4 with the other metal oxides.

Results

Copy and complete the following table:

metal oxide	colour of metal oxide	appearance after heating with carbon
copper(II) oxide		
iron(III) oxide		
magnesium oxide		
lead(II) oxide		
zinc oxide		

Extra work

- Heat each mixture of carbon and metal oxide in a test-tube. Test for carbon dioxide by bubbling the gas through limewater.

Questions

- 1 a) Which reaction occurs most readily?
b) Explain why the mixture of magnesium oxide and carbon becomes white when strongly heated.
c) What is oxidized and what is reduced when copper(II) oxide is heated with carbon?
d) Which metals in the above experiment are commercially extracted using carbon?
e) What other forms of carbon could be used in the experiment?
- 2 Write equations for the reductions that take place.
- 3 Magnesium is high in the reactivity series and so it reacts with carbon dioxide. The reaction can be carried out by plunging burning magnesium into carbon dioxide.
 - a) Draw a diagram of the apparatus that could be used to demonstrate this reaction.
 - b) Describe what you would expect to see.
 - c) Write an equation for the reaction taking place.
 - d) Name one metal that would react more vigorously than magnesium in this experiment.
 - e) Name one metal that would react less vigorously than magnesium in this experiment.